

# SOLEIL Beam Statistics and New Metrics



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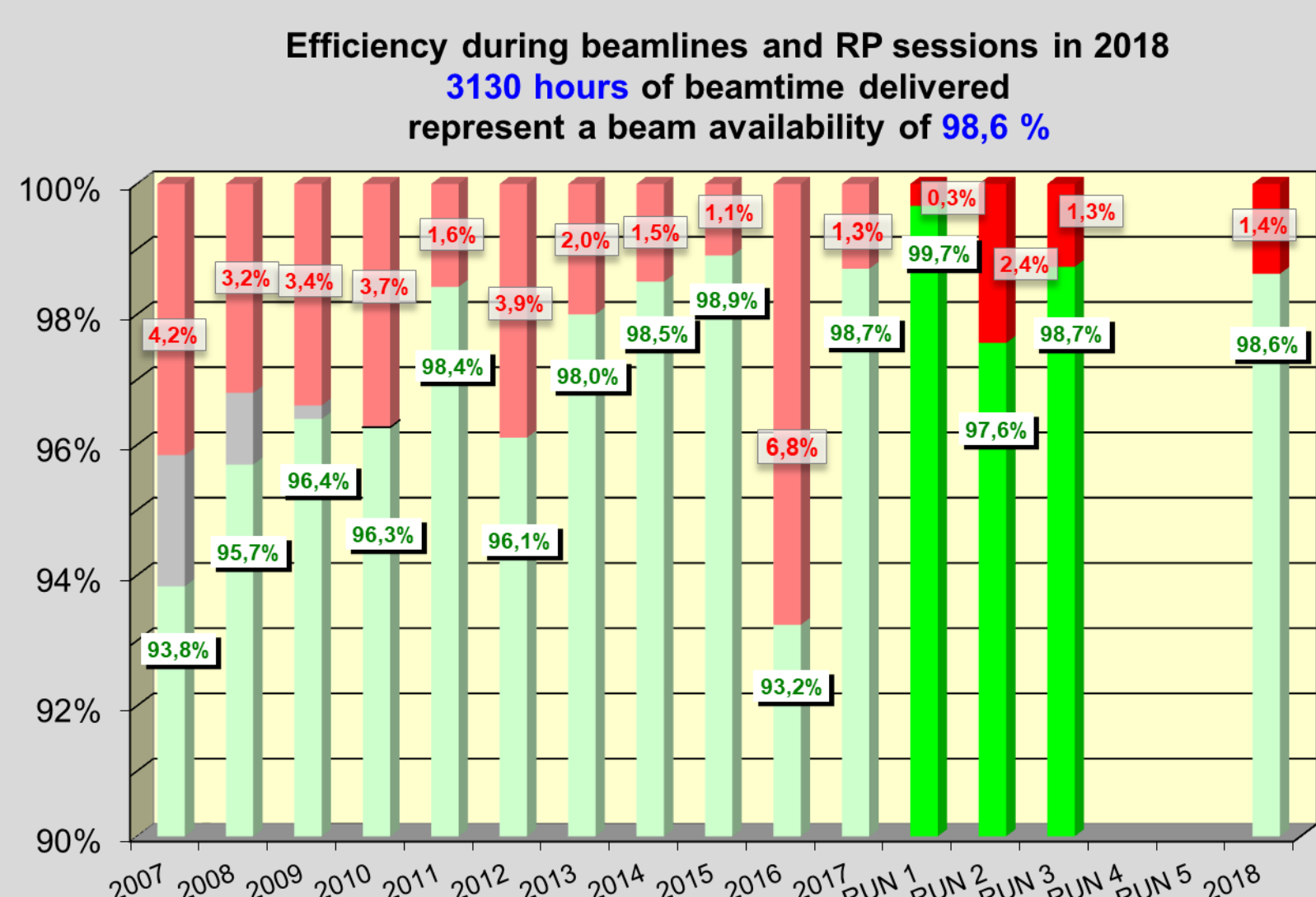
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Synchrotron SOLEIL is the third generation French synchrotron light source. It has been in operation since 2007, providing photon beams to 29 beamlines with a maximum intensity of 500 mA, 5000 hours a year.

2017 has been the second best year for SOLEIL with 98.7 % beam availability (98.9% in 2015) and 92 hours "mean time between failures" (MTBF) (105h in 2015). The target remains 99 % beam availability and 100 h MTBF despite the forthcoming obsolescence and aging of the facility.

We generate statistics that allow us to measure the machine efficiency. We then need tools such as online applications to monitor these statistics at anytime from anywhere. DJANGO (Python web framework) has been used to develop dedicated web pages. Moreover, following the discussions within the community on common metrics to compare similar facilities together, we present in this poster how we generate and use these common metrics.

## Statistics

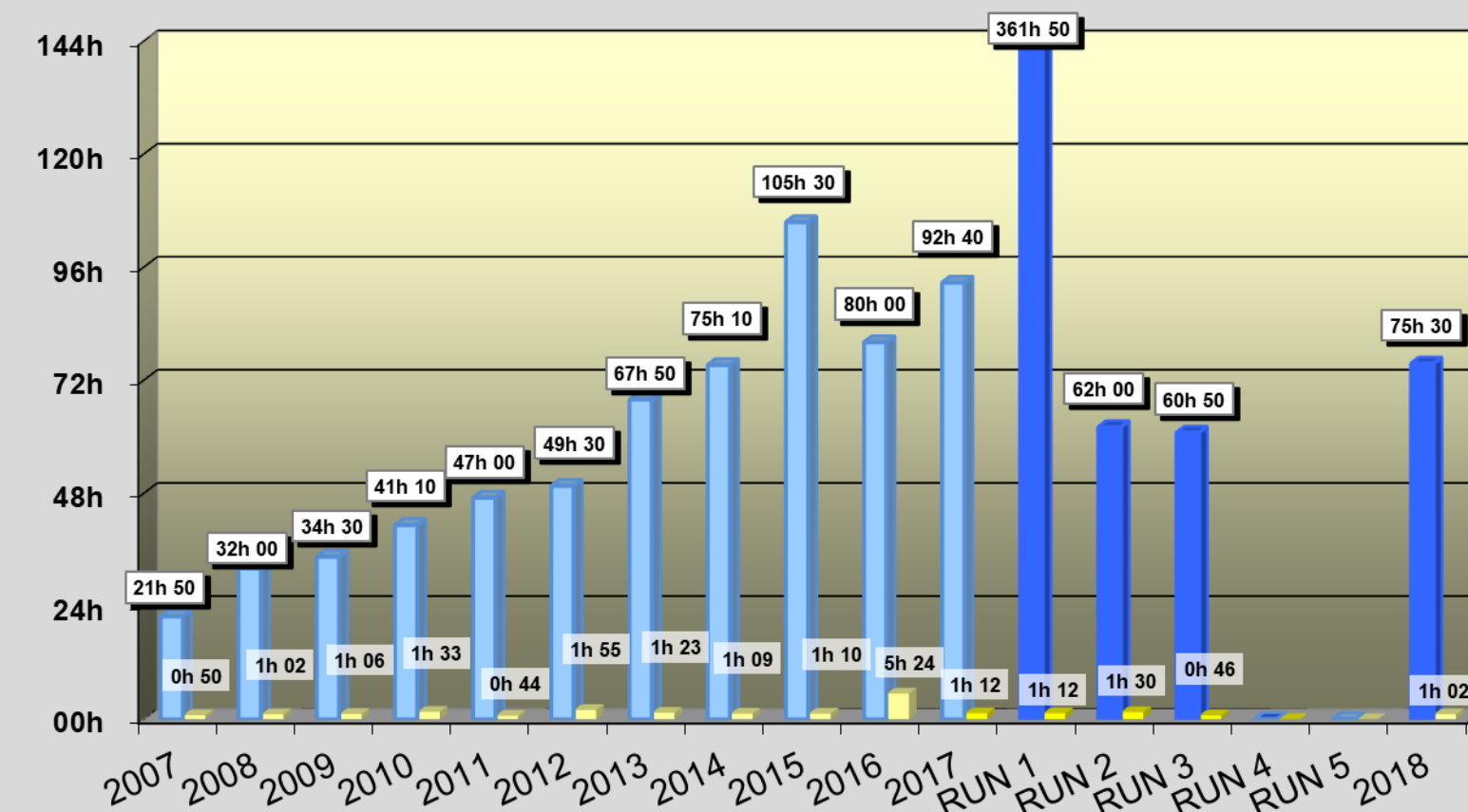


Year	Total beam time	Beam time scheduled for beam lines	Beam availability	MTBF
2007	4 896 h	2 813 h	93,8%	22 h
2008	5 568 h	4 056 h	95,7%	32 h
2009	6 028 h	4 589 h	96,4%	34 h
2010	6 120 h	4 905 h	96,3%	41 h
2011	6 263 h	5 077 h	98,4%	47 h
2012	6 515 h	5 341 h	96,1%	50 h
2013	6 329 h	5 015 h	98,0%	68 h
2014	6 370 h	5 041 h	98,5%	75 h
2015	6 192 h	4 959 h	98,9%	105 h
2016	6 361 h	5 124 h	93,2%	80 h
2017	6 333 h	5 094 h	98,7%	92 h

### Timeline and performances

23/09/2004 → Beginning of accelerator installation  
02/07/2005 → First beam in LINAC  
23/07/2005 → First beam in Booster  
14/05/2006 → First beam in Storage Ring  
02/06/2006 → First beam stored in Storage Ring  
13/09/2006 → First photons on first beam line  
25/09/2006 → 300mA stored with 1 Cryomodule  
24/03/2009 → Top-Up injection, uniform filling at 300 mA  
06/04/2010 → 500 mA, machine radiation safety approved  
09/06/2011 → Top-Up Hybrid mode at 400mA  
03/07/2012 → Top-Up Hybrid mode at 430mA  
16/12/2014 → Opening of the 29th beamline  
02/06/2015 → Top-Up Hybrid mode at 450mA  
15/12/2015 → Top-Up Uniform mode at 500mA

MTBF: Meantime between failures (99h20)  
and MTTR: MeanTime To Recovery (01h28)  
during beamlines and RP sessions in 2017

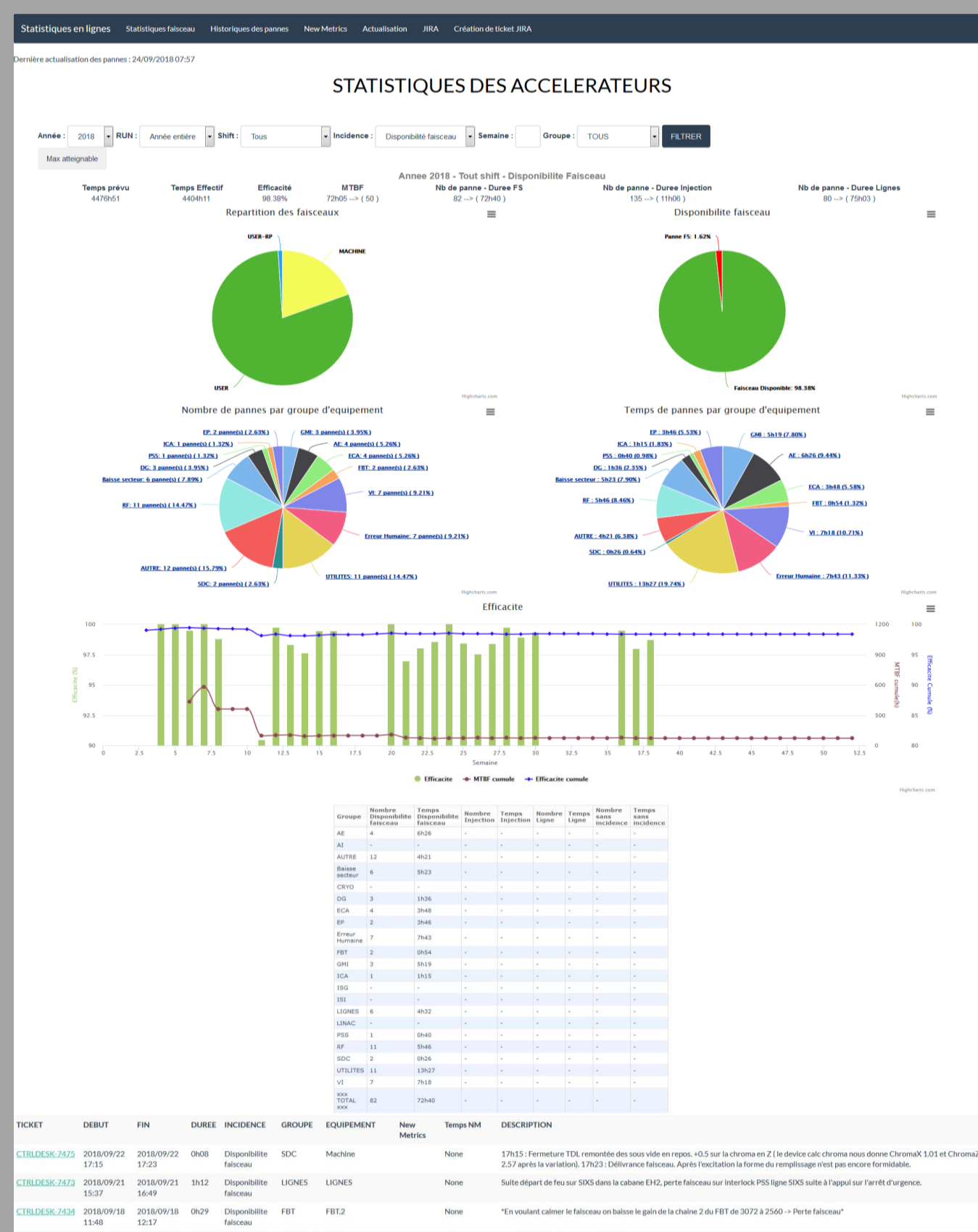
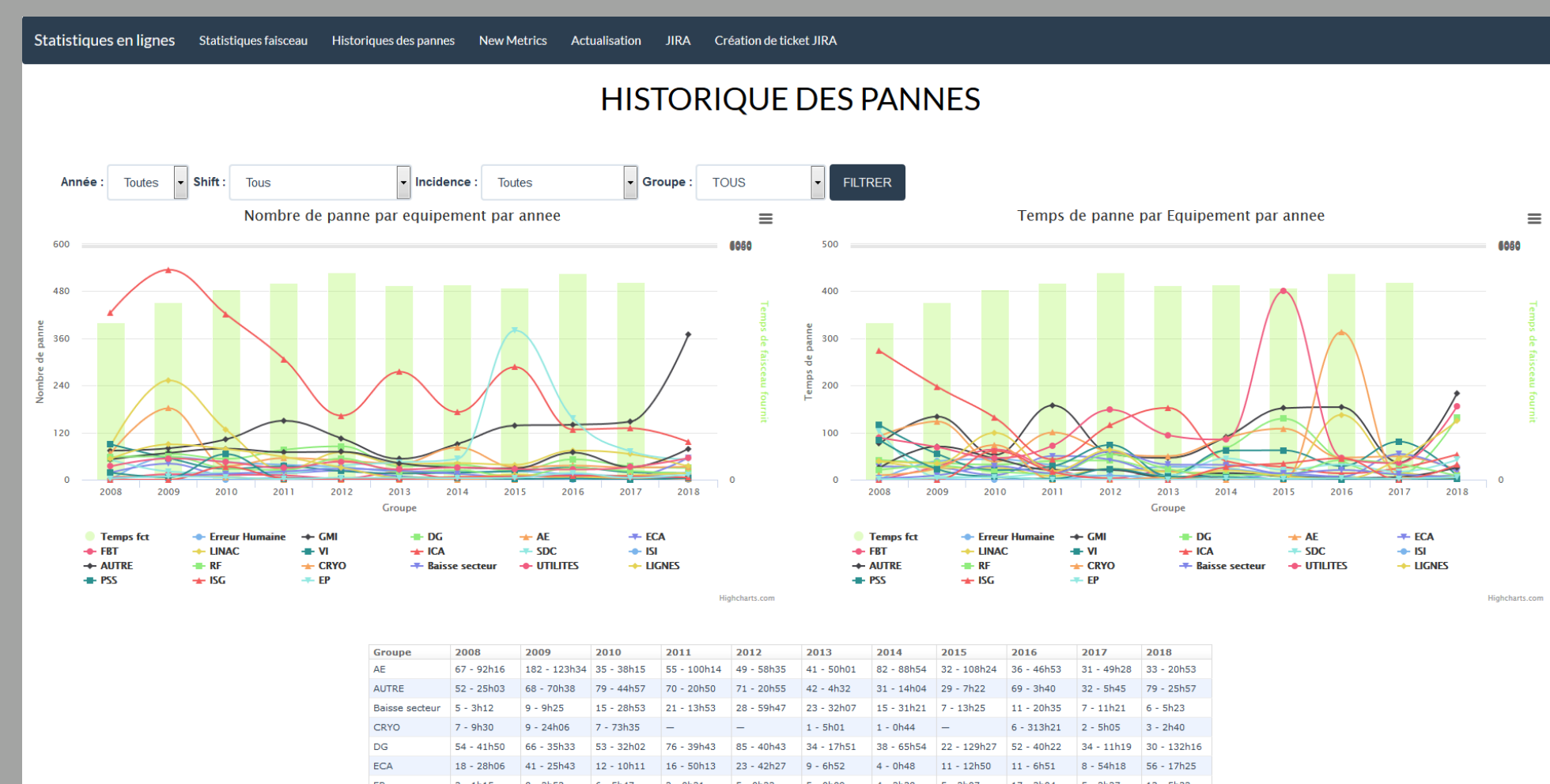


## Statistic Web Based Application

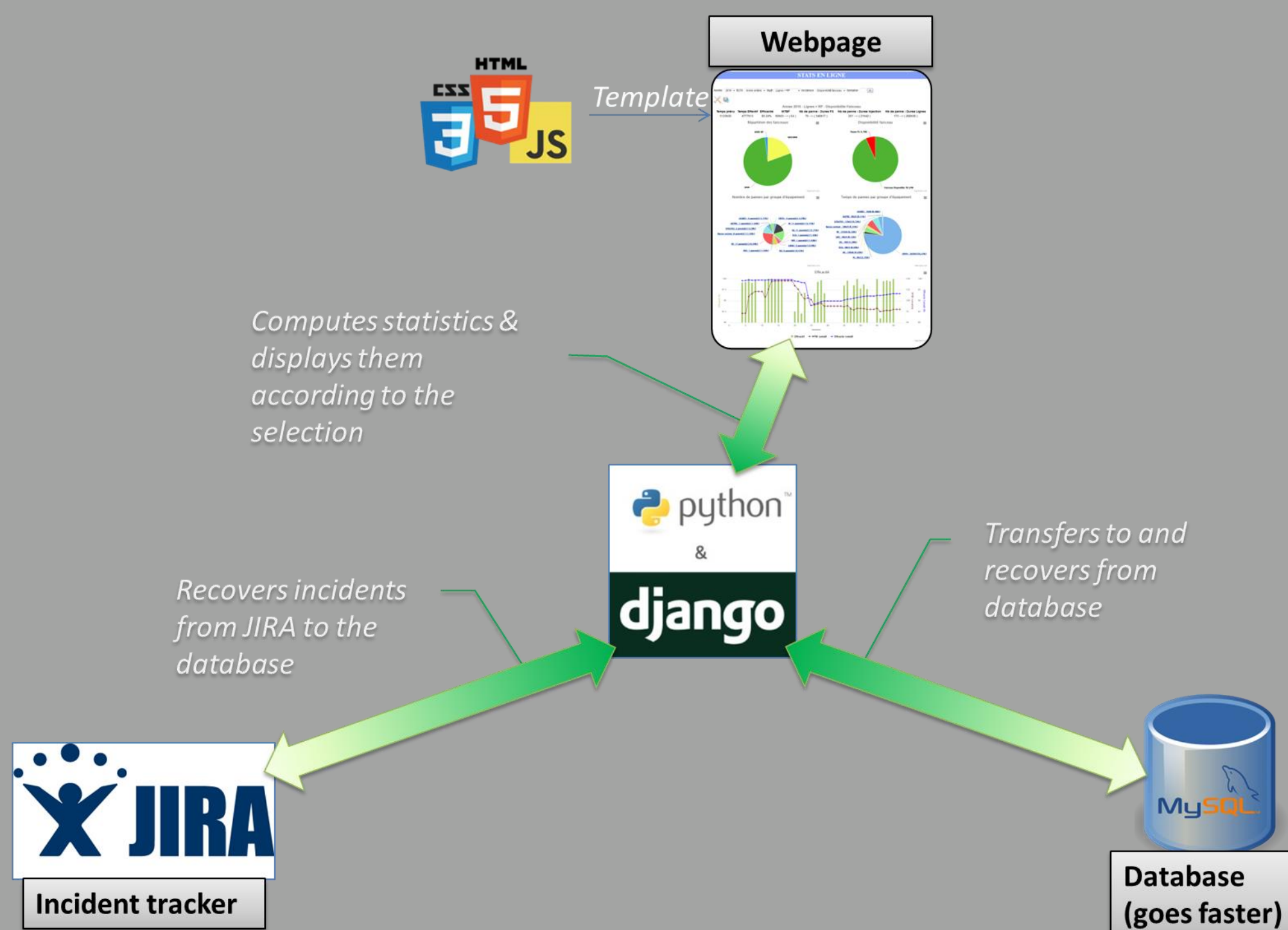
We developed a web based application to have live beam statistics and to access the statistics of the past years (since 2008).

We can also see incident statistics equipment by equipment and new metrics statistics.

People from all the division can access the pages via the intranet



The application is developed thanks with DJANGO (Python web-Framework). The statistics are based on the data reported in the bug tracker (JIRA) by the operator.



## Adapting our Statistics to Common Metrics

### Primary Failure Modes

Stats SOLEIL	2016		2017		Criteria
	Nb	hours	Nb	hours	
No-Beam	64	346,3	55	66,3	→ Start when I = 0 mA & stop when I = Inominal and Front End unlocked → If beam is less than 7% of nominal current we have to close the Front-Ends to reinject (strict safety rules) → Beam count as No Beam if duration < 30'
Top-Up	201	21,9	125	13	→ In multibunch mode, start when the beam current drops below 99.9% of the minimum current. → In single bunch injection, this value is 99.5 %

News Metrics SOLEIL	2016		2017		Criteria
	Nb	Hours	Nb	Hours	
No-Beam	59	345,7	53	66,1	→Start when I < 20% of I nominal & stop I = Inominal (and FE unlocked) → Close Front-End for reinjection is count as Beam Unrelated → Beam less than 30' is count as Short User Time
Low-Beam	30	11,4	26	8,3	Start when I < 99,5% of I.min for all filling modes & stop when I > I.min (Top-Up regulation threshold)

### User Time

years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
User Experiment Time	2639	3881	4423	4722	4997	5133	4912	4963	4904	4777	5028
Scheduled User Experiment Time	3096	4056	4580	4881	5077	5341	5015	5041	5200	5124	5094
Spontaneous User Compensation Time (user re-scheduled < 1 month ago)			8	24					0		
Scheduled User Reserve Time (user re-scheduled > 1 month ago)			0	0					192		
Re-Scheduled User Experiment Time	2813		4589	4905					4959		

Additional time to complete shutdown and to test Beamlines safety system before first opening.

Cryogenic failure, one machine day back to beamlines

Fire in a technical room. Start of the run delayed by 3 Weeks. Compensated by eight days.

### Secondary Failure Modes

Stats SOLEIL	2016		2017		Criteria
	Nb	hours	Nb	hours	
BeamLines	173	267	121	153	Failures with impact on one or several beamlines  → Orbit perturbations: Slow Orbit Feed Back, Fast Orbit Feed-Back, tunnel air-conditioning, cooling water, storage ring or insertion device power supplies, earthquake. → beam size variation: Transverse bunch per bunch Feedback not running, beam excitation (vacuum rise, power supplies default) → Blocking of a front-end opening

News Metrics SOLEIL	2016		2017		Criteria
	Nb	hours	Nb	hours	
Low-Lifetime	0	0	0	0	→ 4h in multibunch (TAU typical 12h) → 2h in single bunch (TAU typical 4h)
Beam Blow-up	1	0,02	0	0	→ +/- 20% of the beam size, more than 10 " (with the FB-Coupling we maintain vertical emittance at +/- 30%)
Distorted Orbit	28	10	6	20	Threshold at source point: 5µm in H (10% Beamsize) and 2µm in V (20% Beamsize) if t > 60 " (min time to restart)
Distorted Filling Bunch Purity	2	105	0	0	→ Distorted filling : No injection in single Bunch or injection in the wrong bunch → Purity typical between 1E-5 and 1E-4, proposed threshold 1E-3 (user threshold)
Beam Unrelated	64	133	52	126	Failures do not affect the beam, but affect the user experiments
Short User-Time	0	0	0	0	Beam less than 30 minutes
Orbit FB Outage	-	-	-	-	Orbit feedback outage are recorded if they have an incident on the orbit
Filling FB Outage	-	-	-	-	No Feedback



## Statistic Web Based Application showing New Metrics

